Postlarval Scombroid Fishes of the Genera *Acanthocybium, Nealotus,* and *Diplospinus* from the Central Pacific Ocean

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EXCLUSIVE of the mackerels and tunas, whose commercial importance has caused them to be studied extensively, the early life history of scombroid fishes is poorly known. This is particularly true of the families Gempylidae and Trichiuridae, even though they are the bases for fisheries in Australia, South Africa, Madeira, and parts of Asia. There is also a paucity of life-history information about the non-schooling Scombridae. This paper describes young stages of the scombroid *Acanthocybium solandri* (Cuvier and Valenciennes), the gempylid *Nealotus tripes* Johnson, and the trichiurid *Diplospinus multistriatus* Maul, all three belonging to monotypic genera. The first has a slight commercial importance (Iversen and Yoshida, 1957:370), the others may be considered rare species of no commercial value.

The three families are taxonomically well known, the Scombridae having been reviewed by Fraser-Brunner (1950), the Gempylidae by Matsubara and Iwai (1952) and Grey (1953), and the Trichiuridae by Tucker (1956). All of these authors dealt essentially with adult fish. Postlarval *Acanthocybium* are hitherto unrecorded, the smallest specimen mentioned in the literature measuring 27 cm (Kishinouye, 1923: 387). Similarly, the smallest *Diplospinus* is 125 mm (Maul, 1948:45), although there is a possibility that a 69 mm *Lepidopus* may in reality be a *Diplospinus* (Tucker, 1956:81). Small *Nealotus* have been recorded by Lütken (1880:458), Günther (1887:35), Norman (1930:351), and Voss (1957:304). Lütken figured his specimens but regarded their identity as dubious. His larger specimen (about 13 mm standard length) has 20 spines in the first dorsal and is probably *Nealotus*. His smaller fish measures only about 8 mm in standard length and cannot be identified with certainty.

All material reported upon here was collected by "British Columbia" trawl during cruise 47 of the Bureau of Commercial Fisheries research vessel "*Hugh M. Smith.*" This cruise took place in October–November 1958, in the central Pacific southeast of Hawaii. A description of the collection method is included in Matsumoto's report (in press) on the young tunas taken on this cruise. Figure 1 locates the trawling stations and capture sites of the species under consideration. Additional data may be found in Table 1 and in the species diagnoses.

Following capture, the fish were preserved in formalin and subsequently transferred to 65% ethyl alcohol. This particular concentration produced less wrinkling, hardening, and distortion than the customarily used 70% solution. Most specimens were stained with alizarin, but clearing the tissues, as with glycerin, was not done.

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Acanthocybium solandri (Cuvier and Valenciennes)

Station 60 1 specimen: 23.7 mm

The single *Acanthocybium* captured is rather easily recognizable in spite of the fact that its

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TABLE 1

STATION DATA, "HUGH M. SMITH" CRUISE 47

STATION NO.	DATE (1958)	ZONE TIME	LATITUDE	LONGITUDE	MAXIMUM HAUL DEPTH (in m)
2	Oct. 9	2005–2300	21° 24′ N	158° 23′ W	139
32	Oct. 27	1315–1523	00° 02′ S	149° 32′ W	85
49	Nov. 2	0843–1027	02° 09′ S	149° 47′ W	99
51	Nov. 2	2013–2158	00° 44′ S	149° 46′ W	85
53	Nov. 3	0838–1018	00° 37′ N	149° 58′ W	86
56	Nov. 4	1030–1210	01° 56′ N	150° 09′ W	98
58	Nov. 4	2013–2153	02° 56′ N	150° 03′ W	93
60	Nov. 5	0820–1002	04° 28′ N	150° 29′ W	96
66	Nov. 6	2005–2152	09° 08′ N	150° 03′ W	96
68	Nov. 7	0820–1007	10° 40′ N	149° 52′ W	93
70	Nov. 7	2015–2148	12° 13′ N	149° 56′ W	96

finlets have not yet differentiated. The fin formulae are D XXVII, 24 and A 22 as a consequence of persistent membranes between the fins and presumptive finlets. The anal formula is additionally misleading in that spines and rays cannot be distinguished. As is apparent from Figure 2, the spacing between the rays of the future finlets is greater than between the rays of the soft dorsal and anal fins. Further demarcating the finlets is the dusky pigment of their membranes. Following finlet formation this fish would presumably have had fin formulae of D XXVII, 14 + 10 and A 12 + 10.

Other characters of this specimen are 23 pectoral rays, I, 5 pelvic rays, 7 branchiostegal rays, and 17 principal caudal rays. All caudal rays, except the 5 mesial ones, have their bases covering the hypurals, tending to conceal the latter. The gill filaments are J-shaped but as yet show no tendency to fuse into the adult gill reticulum. Tooth size and spacing are irregular, in contrast to the homodont adult dentition, with about 28 teeth on each dentary and 25 on each premaxillary. The anterior teeth in both jaws are curved and fanglike. The anterior margin of the preopercle bears a short spine at the angle and another on the lower limb. The posterior margin has two short spines on the upper limb, a long spine at the angle, and five irregular spines on the lower limb. There are two tiny spines on the posterior tip of the pterotic, but these are too small to appear in the drawing. The body is dusted with tiny melanophores, giving a uniform tan color, except on the dorsal part of the snout, which is dark brown.

An unusual feature of this specimen is a conical cartilaginous projection surmounting the mandibular symphysis. This projection has been noted in the adult, but not commented upon (Conrad, 1938:10). A similar structure has phylogenetic significance in relating the Gempylidae and Trichiuridae (Tucker, 1956:123), as well as taxonomic importance within the Gempylidae (Grey, 1953:138). Because its presence in *Acanthocybium* was thought to indicate hitherto unsuspected relationships between the Scombridae and the Gempylidae-Trichiuridae, a search was made for the structure in other scombroids. There is no indication of it in the young of any of the tunas (*Auxis, Euthynnus, Germo, Katsuwonus, Neothunnus, Parathunnus,* and *Thunnus*) according to W. M. Matsumoto (personal communication), but a prominent mandibular protuberance was found in juvenile *Scomberomorus maculatus,* 11.5–19.2 mm in standard length. *Scomberomorus* is regarded as phylogenetically basal to *Acanthocybium* (Fraser-Brunner, 1950:135), and the presence of this jaw projection confirms a close relationship. That there is a tie between these genera and the Gempylidae-Trichiuridae is further indicated by their mutual low-crested crania, elongate compressed bodies, and reduced squamation. In all scombroids examined, including a 565-mm

Gempylus serpens, the jaw protuberance is flexible (and sometimes decurved in *Nesiarchus nasutus*), precluding its use as a spear, and instead suggesting a hydrodynamic function (cf Wisner, 1958: 68).

Nealotus tripes Johnson

Station 2	1 specimen:	176 mm
Station 32	10 specimens:	16.4–41.5 mm
Station 49	8 specimens:	19.6–25.8 mm
Station 51	59 specimens:	10.0–20.2 mm
Station 53	3 specimens:	10.0–22.0 mm
Station 56	4 specimens:	9.0–24.0 mm
Station 58	6 specimens:	21.2–25.0 mm
Station 60	2 specimens:	21.4–28.0 mm
Station 70	1 specimen:	37.0 mm

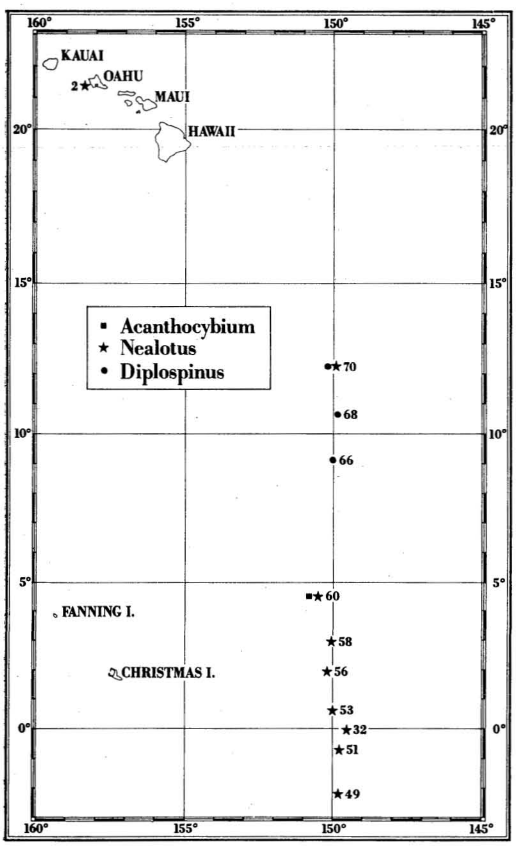

FIG. 1. Trawling stations on "Hugh M. Smith" cruise 47, showing places of capture of *Acanthocybium, Nealotus,* and *Diplospinus.*

When first examined, the smaller specimens listed above were thought to be *Nesiarchus nasutus* Johnson, to which they bear a strong superficial resemblance (cf Voss, 1954). Subsequent staining revealed their salient taxonomic feature, a reduction in the number of pelvic rays, showing that they belonged in a different branch of the Gempylidae, the *Rexea-Promethichthys-Nealotus* group. According to Grey (1953:139), these genera are characterized by a reduction of the pelvic fins to a pair of spines, or by the total absence of these fins. Only the largest of the above specimens, a fish 176 mm in length, has the pelvics reduced to mere spines and thus is referable to *Nealotus tripes.* The remainder range from 9.0–41.5 mm, and have pelvic formulae of I,2 or occasionally I,1 (Table 2). In this length range, as is shown in the following paragraphs, the pelvic rays gradually become overgrown by abdominal tissues, within which they are clearly visible after alizarin staining. At larger sizes the rays presumably are too deep to be seen without dissection or staining. Norman (1930:351) failed to find them in *N. tripes* specimens 53 and 88 mm long. Dissection of the pelvic region of my 176-mm fish revealed fragments of raylike material in the musculature ventral to the pelvic bones. These fragments were fused to the pelvis anteriorly, and appeared to serve as anchoring struts.

In young *Nealotus* individuals there are two prominent spines preceding the anal fin, whereas adults are generally regarded as having only one. My 176-mm specimen conforms to the adult concept externally, but when dissected its perianal region contained a small, flat spine, triangular in outline, embedded behind the first. Matsubara and Iwai (1952:207) also noted a second anal spine, but in their 199-mm fish it is shown as being externally visible.

With an ontogenetic loss of pelvic rays and anal spines, the genus *Nealotus* (and perhaps others) becomes more difficult to define. Characteristic counts are given in Table 2, along with data for *Nesiarchus nasutus,* a species of similar appearance.

Figure 3 depicts the smallest *Nealotus* examined, a fish 9.0 mm in standard length. At this size the vertical fin rays have not all differentiated, the dorsal being XX-I,18 and the anal

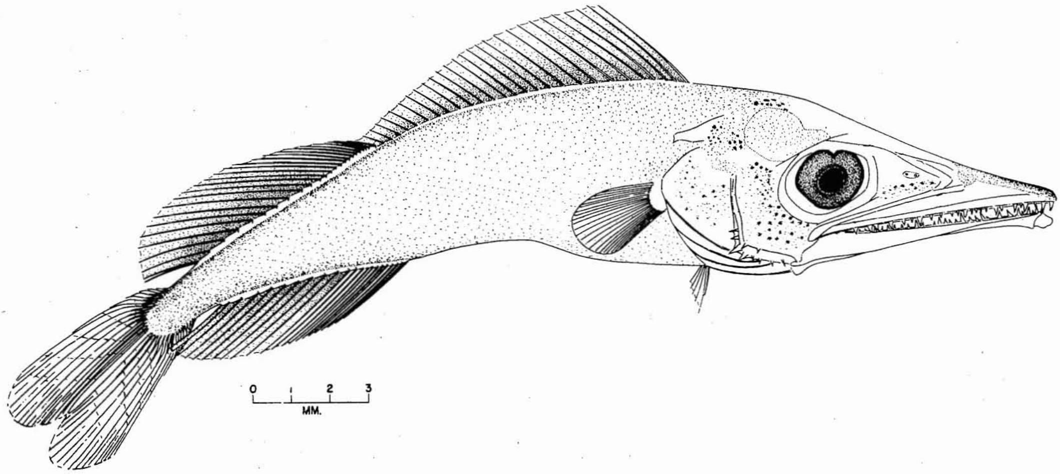

FIG. 2. *Acanthocybium solandri* 23.7 mm in standard length.

II-I,15, with both fins showing rudimentary raylike structures in the membranes posterior to the fins. The principal caudal rays number 9 + 8, the pectorals 13, and the pelvics I,2. Each pelvic spine is long, triradiate in cross-section, and spinigerous on all three edges. The inner pelvic ray is not only much shorter than the outer, but is also membranously bound to the belly anteriorly, whereas the outer ray is free. Like the pelvics, the dorsal spines are triradiate and spinigerous, with the degree of spinulation decreasing posteriorly. The first two dorsal spines bear spinules on all three edges while the rest bear them only laterally; in addition, the number of spinules per spine decreases toward the rear of the fin. The anal spines are like two spiny-edged, short-handled spoons, attached by the bowls with the convex side forward, and the second nesting into the first.

The preopercle bears two strong denticulate spines at its angle and two short smooth spines on its lower limb. The pterotic has two slender spines almost perpendicular to the body surface. A row of 10 denticulations above the eye completes the head armament.

The mandible is prognathous and its tip is surmounted by a small cartilaginous pad. The mandibular symphysis is edentulous, but there are two retrorse fangs on either side of it. About seven short upright teeth are borne on the dentary. There is a large fang on each side of the premaxillary symphysis and a larger one posterior and mesial to the first. About 13 other teeth, some little more than denticulations, occur on the premaxillary. The palatines lack teeth, while the vomer bears a single prominent tooth at each posterior tip.

Pigmentation consists of a brown streak from the top of the head to the rear dorsal base, plus diffuse brown color around the dorso-anterior orbit and along the premaxillary. There is some inconsistency between specimens, probably reflecting differences in chromatophore contraction at death rather than the presence of more than one species.

The 15.6-mm fish shown in Figure 4 differs from the 9-mm one principally in having achieved the adult fin complement (D XX-I, 19 + 2; A II-I, 16 + 2). The two dorsal and anal finlets are connected to each other and to the preceding fins, being detectable only by a variation in spacing. The pelvic spines are as before, but the rays are now adnate to the belly for about half their length. The anal spines have developed a keel on their previously smooth anterior surfaces.

The head armament consists of the two spines at the angle of the preopercle (these now having lost their denticulations), two short spines on the lower limb of the preopercle, a single perpendicular spine on the pterotic, and two posterior spinelike extensions of the strengthening ribs of the opercle. The supraorbital denticulations have been reduced to one or two.

Both the mandible and the upper jaw now bear small cartilaginous symphysial pads, and the dentition is much advanced. Besides the anterior pair of fangs, each dentary has 11 slightly retrorse teeth, and 12 similar teeth are found along the edge of each premaxillary. Anteriorly the premaxillary has 3 or 4 large curved fangs, the posterior ones longest, and all larger than the fangs on the dentary. The vomer has a posterior tooth on each side, and there are about 4 slender teeth located on or near each palatine. Those which are merely near the palatines lack ossified bases. There are as yet no gill-rakers on the first arch.

Pigmentation is again inconsistent between specimens, except for a pronounced dark spot between the first two dorsal spines. Well-marked individuals are colored as is the 9-mm fish; others lack the dark pigmentation of the head and dorsal fin base.

At 31.0 mm (Fig. 5) many of the larval features have been replaced by juvenile characters. The dorsal finlets are still interconnected

TABLE 2

COUNTS MADE ON *Nealotus tripes* AND *Nesiarchus nasutus**

PART	NO.	*Nealotus tripes* (No. specs.)	*Nesiarchus nasutus* (No. specs.)
First dorsal			
spines	19		21
	20	62	2
	21	1	
Second dorsal			
spines	1	63	23
rays	17	26	
	18	35	4
	19	2	8
	20		10
	21		1
Dorsal finlets	2	63	23
Anal			
spines	2–1	25	23
rays	15	2	
	16	14	4
	17	9	17
	18		2
Anal finlets	2	25	23
Pectoral			
rays	12		2
	13	24	21
	14	1	
Pelvic			
spines	1	64	21
rays	0	1	
	1	5	
	2	58	
	4		3
	5		18

* Standard length range: *Nealotus*, 10.0–176 mm; *Nesiarchus*, 11.7–105 mm. Finlets listed as such even if attached to fins by persistent membranes.

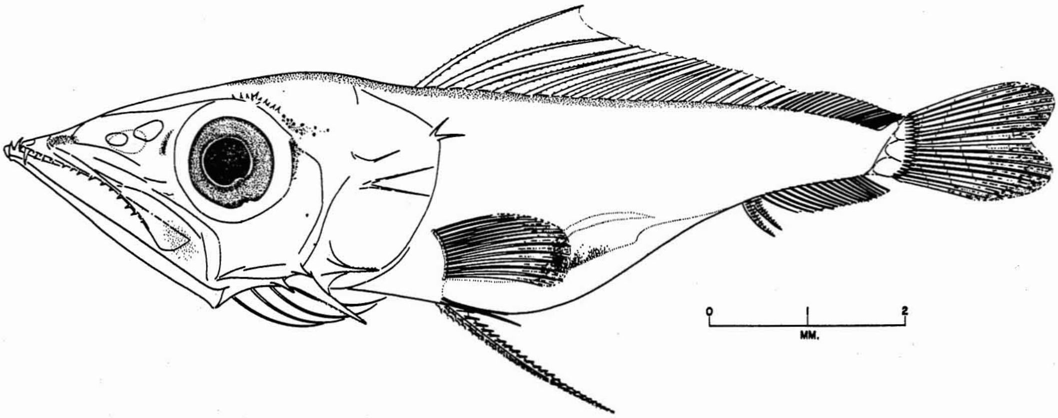

FIG. 3. *Nealotus tripes* 9.0 mm in standard length.

but are free from the last dorsal ray. The same is true of the anal finlets, except that there is a persistent basal membrane between the last anal ray and the first finlet. The dorsal spines have lost the spinules from their anterior edges, and the lateral spinules are less prominent on all fin spines, the space between the spinules having become filled with bony material. The pelvic rays are both buried in epidermal tissues, with the short mesial ray lying deeper than the long lateral one.

The upper spine at the preopercular angle is prominent, but the lower is broad and scarcely noticeable. The lower preopercular limb is smooth, and the opercular spines are reduced in size. The cartilaginous protuberance at the tip of each jaw is conical and well developed. The dentary has 2 anterior fangs and 13 variably smaller teeth; the premaxillary bears 3 anterior fangs and about 16 smaller teeth. The vomer has 2 teeth on each posterior tip, and there are about 6 teeth on or near each palatine. As before, some of the latter are attached to unossified material on the roof of the mouth. There are 3 + 1 + 8 gill-rakers on the first arch, the one at the angle being much larger than the others.

A new feature is the lateral line, a few scales of which are visible on the 31-mm fish. These lie in the skin and are better developed and more numerous anteriorly. In a 35-mm specimen (not shown) the lateral line is nearly completely developed. It is a tubelike structure containing 78 scales and extending from the head to the caudal peduncle. Scale spacing is occasionally irregular, suggesting incomplete development or loss through damage.

Pigmentation consists of rows of tiny, close-set, dark dots, giving an over-all tan color. This is intensified on top of the head, at the jaw tips, along the dorsal base, on the sides of the caudal peduncle, and around the anal spines. The fins lack pigment except for a distal dark spot between the first three dorsal spines.

A 41.5-mm fish (Fig. 6) is essentially a juvenile. Persistent larval features include the slightly denticulate fin spines, the absence of scales except in the lateral line, and basal membranes between the finlets. The pelvic rays are embedded, the two preopercular and two opercular spines are reduced in size, and the symphysial jaw pads are less prominent (and now decurved in the case of the upper jaw). The teeth have increased slightly in number, there now being 3 anterior fangs and 19 lateral teeth on the premaxillary, 2 fangs and 16 lateral teeth on the dentary, 8 or 9 teeth on each palatine (all firmly ankylosed to the palatine and none free on the roof of the mouth), and 1 or 2 elongate teeth posteriorly on each side of the vomer. There are 94 scales in the lateral line but none elsewhere. There are 3 + 1 + 8 slender gill-rakers on the first arch. Pigmentation is as in the 31-mm fish, except that there are now indications of distal dark spots between the first four dorsal spines.

It is unnecessary to figure my 176-mm fish, for it has essentially the same features as the 199-mm specimen shown by Matsubara and Iwai (1952:208). As noted earlier, it differs in having the second anal spine embedded. Other data from my specimen are as follows. The lower jaw has a rudimentary symphysial pad, 1 or 2 anterior fangs on each side, and a row of 17 lateral teeth set closely together like the teeth of a saw. On the premaxillary are 3 large anterior fangs and a row of 21 closely-spaced lateral teeth. The symphysial pad of the premaxillary is blunt, decurved, and scarcely noticeable. The roof of the mouth is overgrown by membranes which, when removed, reveal an edentulous vomer. There are 8 short, blunt denticles on each palatine. The gill-rakers consist of numerous spinules so variable in size, position, and spacing that they cannot be enumerated (cf Matsubara and Iwai, 1952:209). The specimen is partially skinned and the lateral line scales cannot be counted.

Diplospinus multistriatus Maul

Station 66	2 specimens: 103 and 166 mm
Station 68	10 specimens: 10.0–17.4 mm
Station 70	1 specimen: 156 mm

The genus *Diplospinus* is known from Madeira, the West Indies, and the Philippine–East Indian region (Tucker, 1956:79). The above specimens are the first from the central Pacific Ocean. Postlarvae are hitherto unknown, although they and earlier stages have been found for other trichiurids (Delsman, 1927; Padoa, 1956:508–513; Regan, 1916:144–145). The following descriptions and figures illustrate development in which a short, high-bodied postlarva becomes an increasingly attenuate juvenile.

As pointed out by Tucker (1956:81), there is a possibility that *Diplospinus multistriatus* Maul is a synonym of *Lepidopus gracilis* Brauer. The latter was described from a specimen 69 mm in length (Brauer, 1906:291), which differs from *multistriatus* chiefly in characters which change with growth. Although it was impossible to examine the type of *gracilis*, a brief study was made of a feature thought to distinguish it from *multistriatus*, the ratio of standard length to head length. This ratio is plotted against standard length in Figure 7. The data represent the present specimens, the type series of *multistriatus* as described by Maul (1948:45), a recently collected 65-mm *multistriatus* with a SL/HL ratio of 5.5 (Maul, in litt.), and the type of *gracilis*. The curve was derived from the regression of head length on standard length, $\hat{Y} = 3.397 + 0.1350X$, calculated from the above *multistriatus*.

From Figure 7 it would seem that *multistriatus* and *gracilis* are separate species. This is confirmed by the fiducial limits of the head length of *multistriatus* 69 mm in standard length (the length of Brauer's *gracilis*). At this size one can expect a head-length range of 12.3–13.1 mm, using $P_{.01}$ values of t and the formula

$$S\hat{Y} = \sqrt{\frac{1}{n} + \frac{x^2}{Sx^2}}$$

(Snedecor, 1946:120). The 14.25-mm head

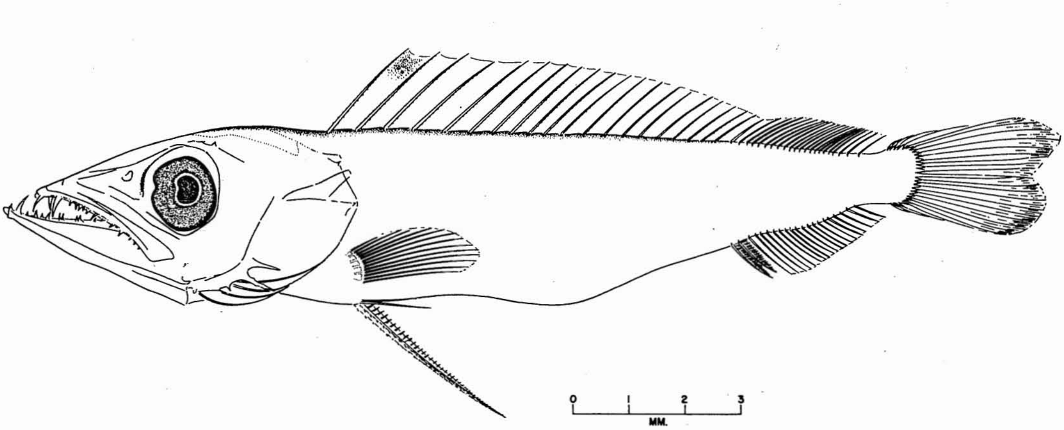

FIG. 4. *Nealotus tripes* 15.6 mm in standard length.

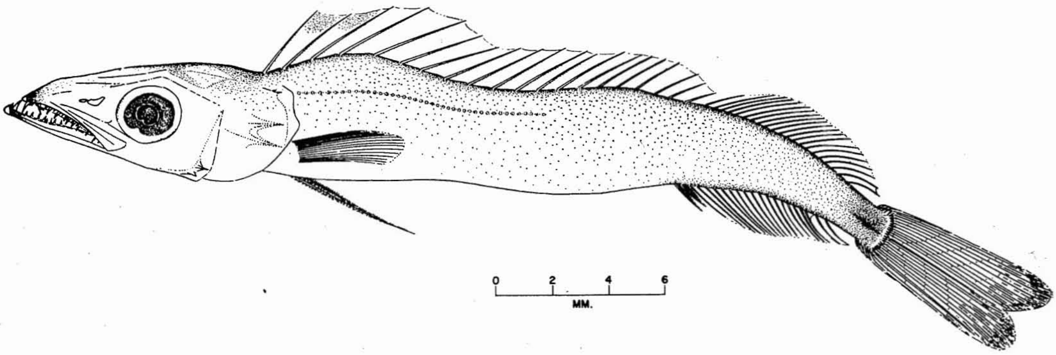

FIG. 5. *Nealotus tripes* 31.0 mm in standard length.

length of *gracilis* lies significantly distant from this range, and the two forms are therefore considered distinct species.

Because not all postlarvae in the 10.0–17.4 mm length range have acquired the adult fin ray complement, it is necessary to list meristic and length data conjointly in Table 3. The number of dorsal and anal fin rays increases irregularly with size. The pectoral, pelvic, and caudal fins and the branchiostegal rays show little or no meristic variation. Except for one specimen with 13 rays on one side and 12 on the other, the pectoral was constant at 12 rays. There were 7 branchiostegal rays and 9 + 8 principal caudal rays, the latter being difficult to count because of damage or nonattainment of definitive shape. In all 13 specimens the pelvic fins are represented by a pair of stout denticulated spines, in agreement with Maul's findings (1948:42) but not with Tucker's (1956: 79–81). The latter, working with a "completely skinned" paratype, observed "Ventral fin I–I; a narrow scale-like spine and an external split ray twice as long." Palmer and Marshall (in litt.) have re-examined this paratype but failed to find the external split ray, observing only the scale-like spine and the pelvic bones. I suggest that Tucker's "ray" was in reality the splintlike pelvis, perhaps loosened in its muscular bed by the force which skinned the fish. In my specimens the attenuate pelvis bears a marked resemblance to a soft ray and is, coincidentally, just twice as long as the pelvic spine.

The most distinctive feature of the 10.0-mm postlarval *Diplospinus* is its relatively great depth at mid-length. As shown in Figure 8, this is caused by a ventral distension of the belly by the elongate pelvic bones, a condition reminiscent of the Balistidae and Monacanthidae, except that in *Diplospinus* the pelvis extends posteriorly. The great depth of *Diplospinus* is quite different from the narrow belly of *Lepidopus* at

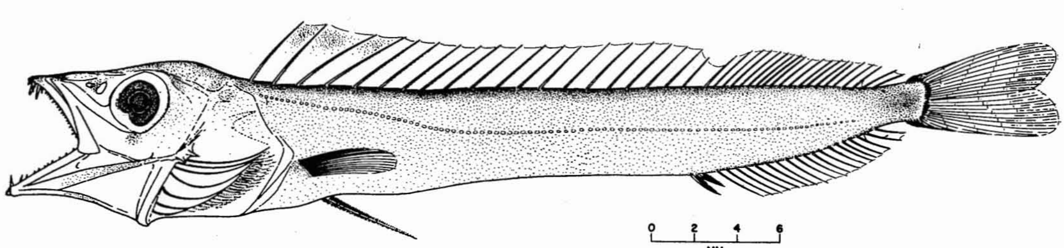

FIG. 6. *Nealotus tripes* 41.5 mm in standard length. The eyes are lacking in this specimen, but have been drawn as they appear in another of about the same size.

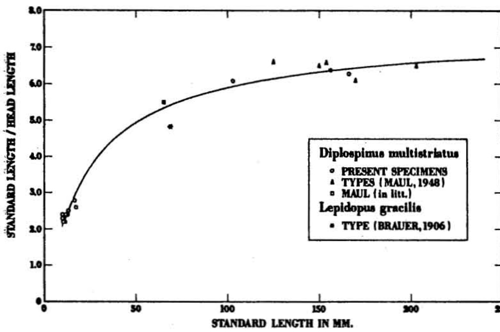

FIG. 7. Standard length/head-length ratio of *Diplospinus multistriatus* and *Lepidopus gracilis.*

this size (Regan, 1916: fig. 7). The abdominal walls of *Diplospinus* are braced laterally by the very long, slender postcleithra.

Attached to each pelvic bone is a hypertrophied pelvic spine, V-shaped or nearly triradiate (through attenuation of the V's apex) in cross-section, with about 20 spinules along each of its three edges. The two detached anal spines and the anterior four or five dorsal spines are similar to the pelvics in shape and armament, while the others are smooth and less obviously triradiate. The low number of soft dorsal rays (Table 3) is probably attributable to damage rather than youth, for a 10.4-mm specimen has 10 more rays in this fin.

The head is armed with a long slightly serrated spine at the preopercular angle, a shorter spine just above it, and two other short spines below, the last three spines being smooth. The three strengthening ribs of the upper opercle project from the opercular edge as slender spines. Dorsal to these projections are two spines at right angles to the body surface: a stout serrated spine on what is probably the pterotic, and a slender smooth one on the post-temporal. Two short spines occur above each eye.

A pair of stout anterolaterally directed tusks lies at each side of the symphysis of the prognathous mandible, these being ventral to the jaw edge, horizontal in position, and unopposed by other teeth. Behind them are three or four retrorse denticles in the anterior half of each dentary, with no teeth posteriorly. The premaxillary has an enlarged tooth at either side of the symphysis, one or two retrorse denticles lateral to this, and six or seven tiny denticles scattered along the rest of its length. The vomer and palatines are ossified but edentulous. There is no trace of a cartilaginous jaw protuberance.

Pigment is restricted to a brown spot distally in the membrane between the first three dorsal spines.

At 13.2 mm (Fig. 9) the postlarva has become more elongate and less high-bodied. There is a variable increase in the number of dorsal and anal rays, and the spinigerous condition has spread posteriorly to include three-fourths of the dorsal spines. The caudal fin is beginning to fork. The preopercular spines are as before, while the post-temporal and pterotic spines are equal in size and both are smooth. The supraorbital spines are short and inconspicuous. A peculiarity of this specimen is its possession of only two opercular-strengthening ribs, each with a spinelike projection. The normal number of ribs, and spines, is three.

Just posterior to its nearly horizontal tusks each dentary bears an upright, unopposed tooth, and behind this is a row of eight emergent teeth extending to the rictus. The premaxillary has a pair of curved fangs on each side of the symphysis, followed by about six teeth of varying size extending to the rictus. The vomer has two prominent teeth on each posterior tip, while the palatines lack teeth. A cartilaginous pad has not yet appeared at either jaw tip. The nasal capsule is visible as a yellowish sub-epidermal sac which lacks external ducts.

TABLE 3

COUNTS MADE ON *Diplospinus multistriatus*

STANDARD LENGTH (mm)	DORSAL FIN	ANAL FIN
10.0	XXX, I, 16*	II–I, 19
10.4	XXX, I, 26	II–I, 20
11.1	XXXI, I, 25	II–I, 19
11.2	XXXII, I, 29	II–I, 22
12.0	XXX, I, 27	II–I, 23
12.1	XXXII, I, 27	II–I, 20
12.6	XXX, I, 30	II–I, 29
13.2	XXXI, I, 30	II–I, 23
16.5	XXXI, I, 33	II–I, 27
17.4	XXXI, I, 35	II–I, 28
103	XXX, I, 37	II–I, 31
156	XXXII, I, 35	II–I, 28
166	XXXII–I, 38	II–I, 30

* Damaged (?).

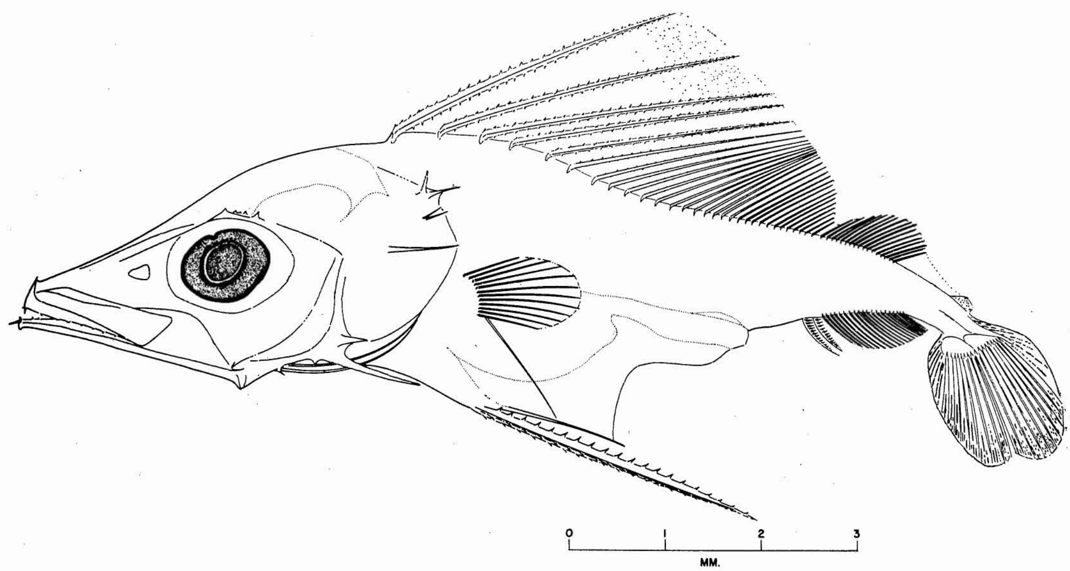

FIG. 8. *Diplospinus multistriatus* 10.0 mm in standard length.

Pigment consists of the distal brown spot in the spinous dorsal, large melanophores on top of the head and occiput, and diffuse brown color anterior to the eye, posteriorly on the maxillary, in front of the pelvic bases, and on the branchiostegal membranes.

Definite indications of the forthcoming ribbon shape are seen in the 17.4-mm postlarva (Fig. 10). There is little trace of the earlier abdominal distension and the head is relatively short. The adult fin ray complement has been attained, although the fins are immature in that their spines still bear spinules. The pelvics are still excessively large and the caudal is well forked.

On the head, the preopercular spines are as before except that those on the lower limb are shorter and stouter. The opercular ribs and

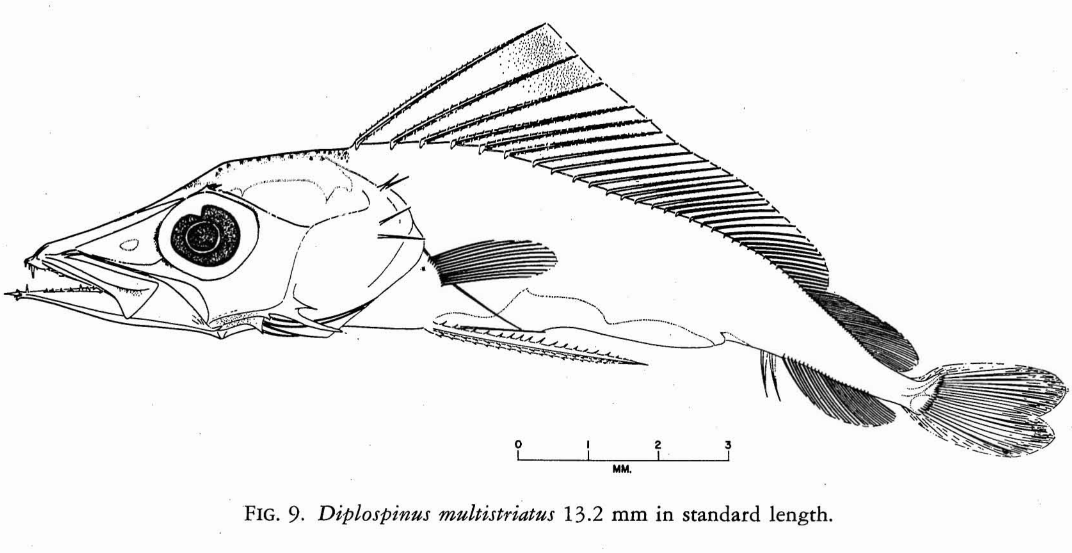

FIG. 9. *Diplospinus multistriatus* 13.2 mm in standard length.

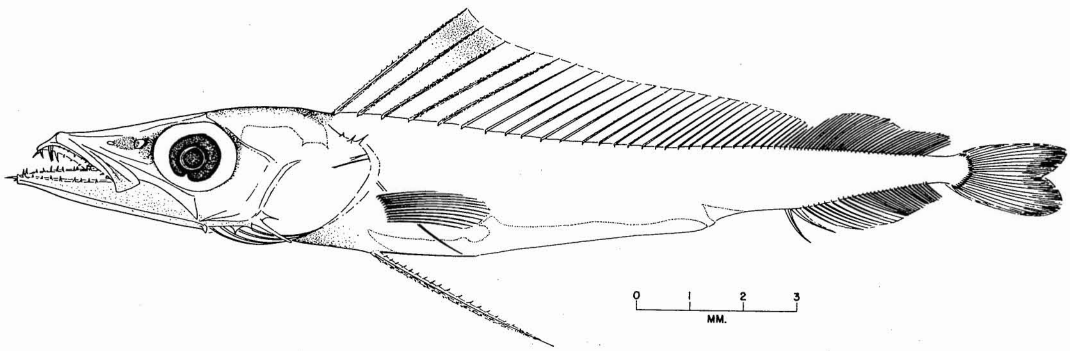

FIG. 10. *Diplospinus multistriatus* 17.4 mm in standard length.

spines and the post-temporal and pterotic spines are likewise little changed. A single low spine, actually little more than a crest, occurs above each eye. The upper of the two tusks on the dentary is much the larger, and the upright tooth posterior to the tusks equals it in size. About 15 curved teeth, some occurring as pairs, occupy the length of the dentary. Anteriorly the premaxillary has 3 or 4 greatly enlarged fangs, the anterior 1 or 2 about half the size of the others. Behind the fangs is a row of about 10 short teeth similar to those of the dentary. The vomer still has 2 teeth near each posterior tip, and these are attached on the inner surface of the bone rather than to its crown. Each palatine bears 6–8 short denticles. There are 3 + 1 + 11 long, slender gill-rakers on the first arch. The nasal capsule has 2 openings, an oval anterior nostril and an irregular posterior one. The nostrils must form suddenly, for they are not present in a 16.5-mm specimen. Small patches of cartilage surmount the tips of both jaws, where they appear to do nothing more than smooth over irregularities in the bones.

Large melanophores occur on top of the head, but give way to smaller ones which extend in a narrow line from the occiput along the entire base of the spinous dorsal. Dark pigment overlies the nasal capsule and occurs as a ring around the orbit. The maxillary, posterior dentary, and pre-pelvic and branchiostegal regions are also dusky, and there is a dark spot in the spinous dorsal fin membranes. (These membranes are damaged in the 17.4-mm fish and the spot is drawn as it appears in a 16.5-mm specimen.)

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